	L #	Hits	Search Text	DBs	Time Stamp
1	L2	1	("20020031906").PN.	US-PGPUB; USPAT; USOCR	2005/03/25 15:37
2	L3	2540	organosilicate or OSG	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	2005/03/25 15:37
3	L4	102	etch$6 near4 3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	2005/03/25 15:37
4	L5	21834	"CHF.sub.3" or "CH.sub.2F.sub.2" or "CH.sub.3F" or "CF.sub.4" or "C.sub.2F.sub.6"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	2005/03/25 15:38

	L #	Hits	Search Text	DBs	Time Stamp
5	L6	2868806	hydrogen or nitrogen or oxygen or argon or helum or "H.sub.2" or "N.sub.2" or "O.sub.2" or Ar	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	2005/03/25 15:39
6	L7	52	4 and 5 and 6	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	2005/03/25 15:39
7	L8	30	7 and ((@ad<"20010723") or (@rlad<"20010723"))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	2005/03/25 15:40

DOCUMENT-IDENTIFIER: US 20020031906 A1

TITLE: Defect and etch rate control in trench etch for dual damascene patterning of low-k dielectrics

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Abstract Paragraph - ABTX (1):
A dual damascene process for low-k or ultra low-k dielectric such as organo-silicate glass (OSG). After the via (112) **etch, a trench (121) is etched in the OSG** layer (108) using a less-polymerizing fluorocarbon added to an etch chemistry comprising a fluorocarbon and low **N.sub.2/Ar** ratio. The low **N.sub.2/Ar** ratio controls ridge formation during the trench etch. The combination of a less-polymerizing fluorocarbon with a higher-polymerizing fluorocarbon achieves a high etch rate and defect-free conditions.

Continuity Related Application Date - RLFD (1):
20000911

Summary of Invention Paragraph - BSTX (10):
[0009] A dual damascene process for low-k and ultra-low-k dielectrics is disclosed herein. After the via etch, a trench is etched using a less-polymerizing fluorocarbon added to an etch chemistry comprising a fluorocarbon and low **N.sub.2/Ar** ratio. The low **N.sub.2/Ar** ratio controls ridge formation during the trench etch. The combination of a less-polymerizing fluorocarbon with a high-polymerizing fluorocarbon achieves a high etch rate and defect-free conditions.

Detail Description Paragraph - DETX (7):
[0023] Referring to FIG. 2A, vias 112 are etched through the barc and the capping layer 110 (if present), IMD 108, and ILD 106. The via etch-stops on etch-stop layer 104. Vias 112 are formed in areas where connection is desired between two metal interconnect layers. If an additional etch-stop

layer was
included between IMD 108 and ILD 106, the via etch also etches through this
additional etch-stop layer. In the preferred embodiment, the via etch
chemistry comprises C.sub.5F.sub.8, **N.sub.2** and CO.

Detail Description Paragraph - DETX (11):
[0027] The trench etch comprises an etch chemistry of a less-polymerizing
fluorocarbon with a more-polymerizing fluorocarbon, **nitrogen and argon**. A low
N.sub.2/Ar ratio (<1:3) is used. A less-polymerizing fluorocarbon refers to
a C:F ratio of less than 1:3. Examples of less-polymerizing fluorocarbons
include **CF.sub.4**, NF.sub.3, **C.sub.2F.sub.6**, and C.sub.XF.sub.3X+Y (Y>=0).
Examples of more-polymerizing fluorocarbons include C.sub.4F.sub.8, C.sub.5F.sub.8, C.sub.4F.sub.6, C.sub.XH.sub.YF.sub.2X+Z (Z>=0, Y>=0).

Detail Description Paragraph - DETX (12):
[0028] The etch chemistry for the trench etch is critical. One proposed
etch for etching OSG is C.sub.4F.sub.8**/N.sub.2/Ar**. C.sub.4F.sub.8 is a
higher-polymerizing fluorocarbon. A high **N.sub.2/Ar** ratio results in high etch
rate. However, when a high **N.sub.2/Ar** ratio is used, oxide ridges 130 form
around the vias, as shown in FIG. 3. 10 sccm of C.sub.4F.sub.8 and a
N.sub.2/Ar ratio of 300:100 results in an etch rate of approximately 4600
.ANG./min. Oxide ridges 130 remain even after clean-up and significantly impact
reliability. When the subsequently deposited metal barriers are formed, it is
difficult to ensure that oxide ridges 130 are completely covered. In addition,
oxide ridges may fall into the vias during subsequent processes (e.g.,
pre-sputter etch), resulting in poor metal barrier coverage.

Detail Description Paragraph - DETX (13):
[0029] A low **N.sub.2/Ar** ratio eliminates the oxide ridges as shown in FIG.
4. Unfortunately, the etch rate also reduces significantly. When 10 sccm of
C.sub.4F.sub.8 is used with a **N.sub.2/Ar** ratio of 50:450, the etch

rate reduces
to approximately 1350 .ANG./min. The low etch rate reduces throughput.

Detail Description Paragraph - DETX (14):
[0030] The etch chemistry according to the invention, combines a less-polymerizing fluorocarbon, such as **CF.sub.4** with a higher-polymerizing
fluorocarbon, such as C.sub.4F.sub.8, and low **N.sub.2/Ar** ratio. The low
N.sub.2/Ar ratio eliminates the oxide ridges, as shown in FIG. 5. The combined
fluorocarbons improve etch rate without increasing oxide ridges or increasing
CD bias. A 10 sccm C.sub.4F.sub.8, **N.sub.2:Ar**=100:300 and 30 sccm **CF.sub.4**
etch chemistry results in no oxide ridges, an etch rate of approximately 3480
.ANG./min and a CD bias of approximately 0.003 .mu.m.

Detail Description Paragraph - DETX (15):
[0031] Because **CF.sub.4** is a less-polymerizing fluorocarbon, adding it to
the etch chemistry increases the etch rate significantly. However, it does not
increase the CD bias or cause the formation of ridges. Thus, the etch rate and
ridge formation can be controlled independently. Furthermore, by adjusting the
flow rates of the two fluorocarbons, various C:F ratios can be achieved. This
is not possible with a single fluorocarbon.

Claims Text - CLTX (2):
1. A method of forming an integrated circuit, comprising the steps of:
forming a dielectric layer having a dielectric constant less than 3.5 over a
semiconductor body; forming a via in said dielectric layer; forming a trench
pattern over said dielectric layer; etching a trench through a portion of said
dielectric layer using an etch chemistry comprising a less-polymerizing
fluorocarbon, a higher-polymerizing fluorocarbon, **nitrogen and argon** with a low
nitrogen:argon ratio; and forming a metal layer in said via and said trench.

Claims Text - CLTX (3):

2. The method of claim 1, wherein said etch chemistry comprises **CF.sub.4** as the less-polymerizing fluorocarbon, C.sub.4F.sub.8, **N.sub.2 and Ar**.

Claims Text - CLTX (4):
3. The method of claim 1, wherein the **nitrogen: argon** ratio is less than 1:3.

Claims Text - CLTX (5):
4. The method of claim 1, wherein the **nitrogen:argon** ratio is approximately 100:400.

Claims Text - CLTX (13):
12. A method of forming an integrated circuit, comprising the steps of: forming a first metal interconnect layer over a semiconductor body; forming an etch-stop layer over said first metal interconnect layer; forming a dielectric layer comprising organo-silicate glass over said etch-stop layer; forming a via through said dielectric layer to said etch-stop layer; forming a trench pattern over said dielectric layer; dry etching a trench in said dielectric layer, said dry etching a trench step using an etch chemistry comprising a less-polymerizing fluorocarbon, a more-polymerizing fluorocarbon, **nitrogen and argon**; and forming a metal layer in said via and said trench.

Claims Text - CLTX (14):
13. The method of claim 12, wherein said less-polymerizing fluorocarbon comprises **CF.sub.4**.

Claims Text - CLTX (16):
15. The method of claim 12, wherein said etch chemistry comprises a **nitrogen: argon** ratio of less than 1:3.

Claims Text - CLTX (17):
16. The method of claim 12, wherein said etch chemistry comprises a **nitrogen: argon** ratio of approximately 100:400.